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A REVISION OF THE GENUS *NEPHASOMA* (SIPUNCULA: GOLFINGIIDAE)

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Abstract.—The species in the sipunculan genus *Nephasoma* (formerly a subgenus of *Golfingia*) are reviewed and evaluated in light of a critical examination of 13 historically used morphological characters. Whenever possible, type material was examined. The monograph of Stephen and Edmonds (1972) was used as a starting point. Of the 46 putative species listed in that work or described since then, 23 remain as valid species, three are reduced to subspecific rank, five are considered either species inquirendum or incertae sedis, and the remainder are considered junior synonyms. One new subspecies is described (*N. diaphanes corrugatum*). The known distribution of each species is summarized. A key to all species is provided.

This paper is part of a continuing series begun in Cutler and Murina (1977) where all of the taxa then considered subgenera of *Golfingia* were reviewed in a preliminary fashion. The sipunculan genus *Golfingia* was created by Lankester in 1885 to commemorate a pleasant outing on the greens. In 1950 W. K. Fisher created five subgenera including *Phascoloides*. One of the species in the group was *G. (P). glacialis* which Cutler and Murina (1977) subsequently showed to be conspecific with *Nephasoma marinki* Pergament. This species name is a junior synonym but, unfortunately, the genus-group name is senior to *Phascoloides* and therefore must be retained as the name of this taxon. The retention of *Nephasoma* as a separate monotypic genus by Stephens and Edmonds (1972) is unfortunate and potentially confusing. When Cutler and Gibbs (1985) elevated *Nephasoma* to generic rank it had a different meaning, i.e., a polytypic taxon with the species formerly included within *Golfingia* (*Phascoloides*). This confusion is further compounded since Gibbs (1982) determined that *N. glacialis* is a junior synonym of *N. lilljeborgi*.

This review is one of a series critically examining the morphological characters used by taxonomists to characterize species within a genus and evaluating their meaningfulness within populations made up of varying size and age worms. We have examined the type material wherever possible and reevaluated the original descriptions based on our current understanding of a species as a group of reproductively isolated individuals within which there is variation. This effort has already been concluded for four of the six taxa considered *Golfingia* subgenera in Cutler and Murina (1977): *Mitosiphon* (Cutler 1979), *Golfingiella* and *Siphonoides* (Cutler et al. 1983), and *Thysanocardia* (Gibbs et al. 1983). The remaining group (*Golfingia* sensu stricto) is currently being revised and will be presented in the near future.

The genus *Nephasoma* is more difficult than many because of the small size of adult worms (many with diameters less than 1 mm) and the paucity of obvious characters. Many of the 'useful' features are located on the distal end of the introvert which is only rarely extended in preserved material (hook size/shape/arrangement and tentacle number/form). This genus is also very common (hundreds of individuals per sample) in deep-water collections made in recent years.

The need for a useful and biologically valid classification is especially pressing. This preliminary effort is directed towards this need.

In the following text we use these abbreviations for the indicated institutions: Zoological Museum, University of Bergen (ZMUB); British Museum of Natural History, London (BMNH); National Museum of Natural History, Washington (USNM); Zoological Institute, Academy of Sciences, Leningrad (ZIAS); Museum für Naturkunde, Berlin (MNHU); Irish National Museum, Dublin (INMD); Institut voor Taxonomische Zoölogie, Amsterdam (ZMUA).

Remarks on the '*minutum*' Section

Since the early part of this century biologists have been confounded by one subset within this group of worms, i.e., those with reduced tentacular lobes, small, scattered, transparent, possibly deciduous hooks, normal body proportions, a nondistinct internal anatomy, and no unique external feature. This paper retains several names which have, at various times, been included in this complex. Now that *N. minutum* has been more narrowly defined (Gibbs 1975, 1977a) and *N. abyssorum* can be distinguished, we are left with *N. diaphanes* (with a new subspecies) and *N. lilljeborgi*. While these may be conspecific, only subsequent work using different methods of analysis will tell with any certainty. When one has only a few animals, some large and smooth and others small and papillated, it is easy to separate them into two sets. However, when one is working with hundreds of specimens the distinctiveness blurs and it becomes very difficult to draw a clear line. In terms of almost all the 'standard' characters, these taxa are identical, but after long deliberation we have decided to retain the two names (adding one subspecies) with much ambivalence. The written descriptons of these taxa cannot adequately communicate what one sees and is only an approximation.

Anyone conducting zoogeographical analyses of marine animals would be wise to exclude these species (as well as all their junior synonyms, especially *N. minutum*) from their works. There has been so much confusion over the years that it would be necessary to reexamine each collection in order to revalidate them within the current usage.

Nephasoma Pergament, 1946

Type species.—*Nephasoma marinki* Pergament, 1946 [=*Onchnesoma glaciale* Danielssen & Koren: Cutler & Murina, 1977; =*Phascolosoma lilljeborgii* Danielssen & Koren: Gibbs, 1977] by monotypy.

Diagnosis.—Species generally small- to medium-sized (trunk less than 5 cm in length). Introvert about equal to, or shorter than, trunk. Hooks present, usually scattered (arranged in rings in *N. rimicola* (Gibbs), in spirals in *N. abyssorum* (Koren and Danielssen)). Body wall with continuous muscle layers. Oral disk carrying tentacles arranged around the mouth but tentacles may be reduced in both size and number and restricted to dorsal region. Two introvert retractor muscles often partially fused. Contractile vessel without villi. Spindle muscle not attached posteriorly. Two nephridia.

This genus now contains all those species previously assigned to the *Golfingia* subgenus *Phascoloides* Fisher, 1950, since *Nephasoma* Pergament has been shown to have priority over *Phascoloides* (Cutler and Murina 1977). The endings of some species names have been modified in accordance with the ICZN as *Nephasoma* is a neuter name.

Morphological Characters of *Nephasoma*

In their description of species, biologists have used a variety of morphological characters to differentiate these entities. These descriptions were legitimate attempts but not always based on a good understanding of possible variation within a population (species). In this section we evaluate these

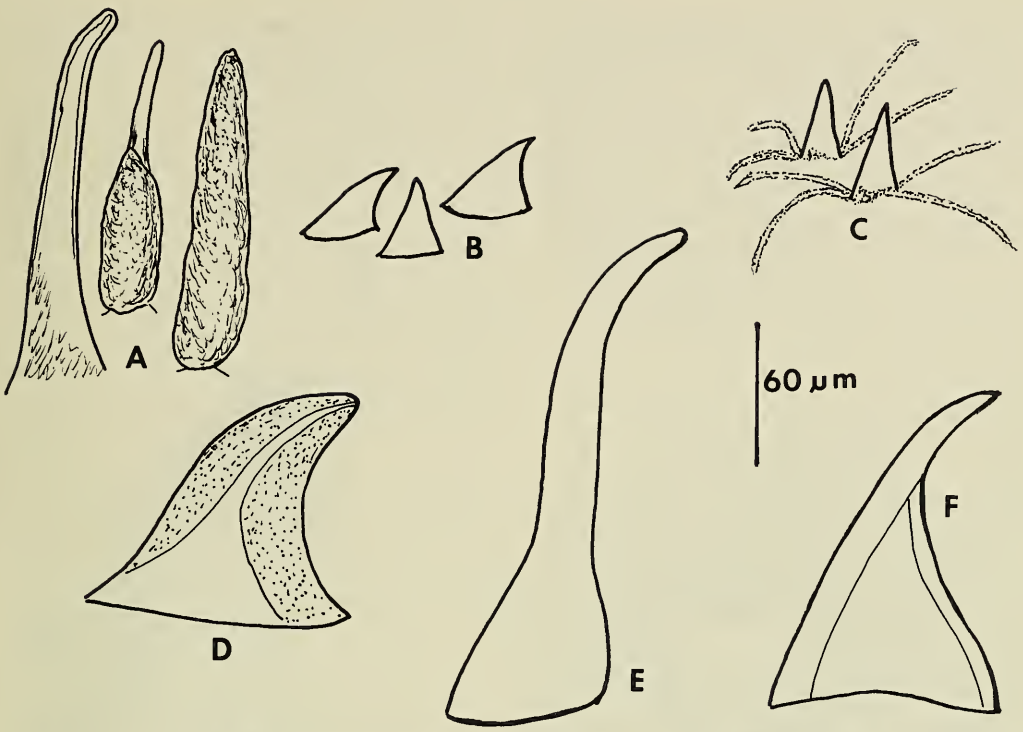

Fig. 1. Introvert hooks of *Nephasoma* species; A, *N. laetmophilum* (after Fisher 1952); B, *N. minutum*; C, *N. multiareneusa*; D, *N. confusum*; E, *N. constricticervix*; F, *N. abyssorum*. All drawn to same scale.

characters in light of our experience with large sample sizes.

1. Introvert hooks.—The presence or absence of hooks on the distal portion of the introvert throughout the life of a worm has been presumed to be a species–specific character by many, but not all authors (e.g., Gerould 1913; Selenka 1885; Southern 1913: 22). Our experience confirms the suggestions that while this may be true in some cases there are many species which have hooks as young individuals but lose them with age. For example, *N. abyssorum* seems to retain its hooks throughout its life and *N. eremita* is said to never have hooks. Our concern, which can only be answered by breeding and rearing worms, is: If one had young *N. eremita* in hand which did have hooks, one would probably put another name on it, i.e., that of a hooked species. Contrariwise, if there are large *N. abyssorum* without hooks, one would be inclined to identify these as some hookless species. An additional problem arises if one has an incomplete/damaged worm or one which is regenerating an introvert missing as the result of predation.

There are some useful attributes when hooks can be seen. A few species have very characteristic shapes or sizes (see *N. confusum, N. constricticervix,* or *N. multiareneusa*) or unique arrangements (*N. abyssorum, N. rimicola*). However, most species have small, bluntly triangular, transparent, scattered hooks about 20–40 µm tall. There are six species with hooks 50–150 µm tall (*N. abyssorum, N. confusum, N. cutleri, N. laetmophilum, N. rimicola, N. schuttei*), and only two with hooks frequently more than 150 µm tall (*N. vitjazi* and *N. constricticervix*).

While we are uncertain and skeptical, our operational assumption is that three sets of species exist within this genus: Those which

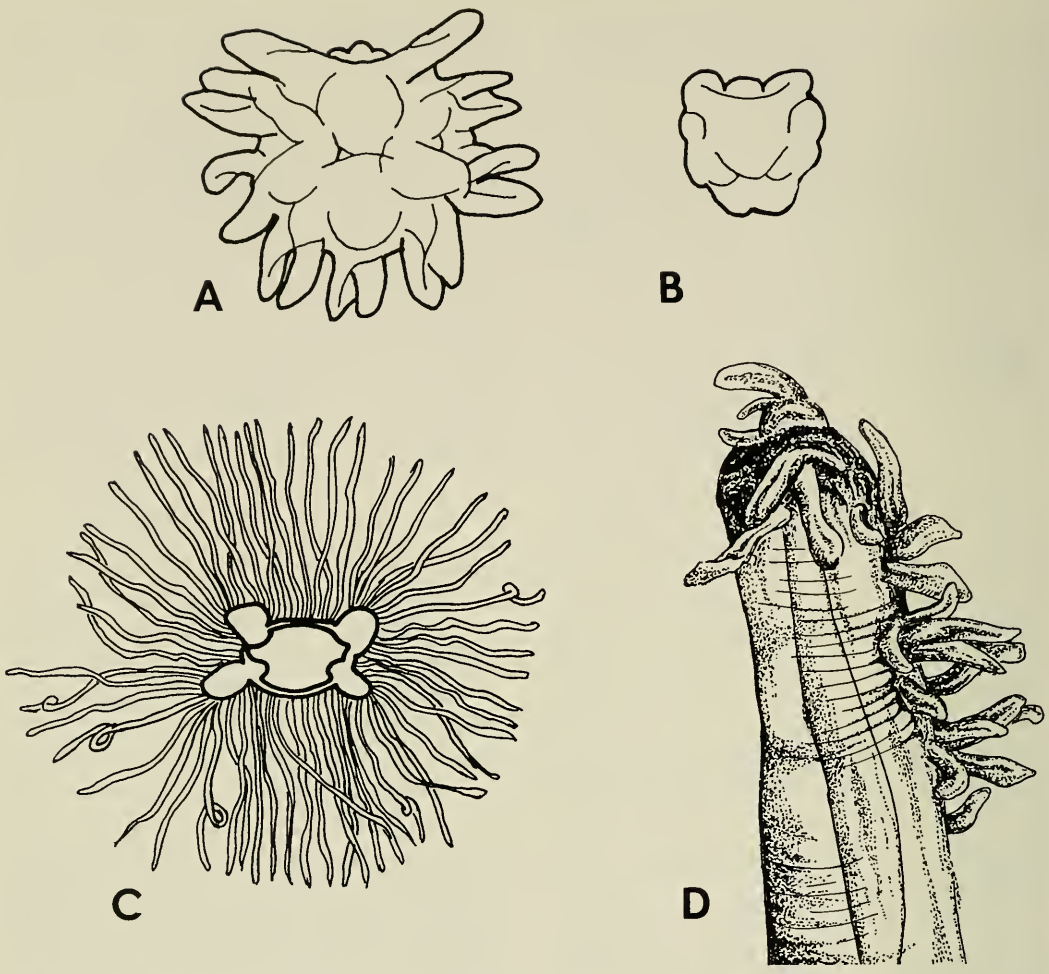

Fig. 2. Tentacles of *Nephasoma* species; A, *N. rimicola*; B, *N. minutum* (A and B from Gibbs 1977a); C, *N. novaezealandiae* (after Benham 1904); D, *N. rutilofuscum* (from Cutler and Cutler 1979a).

never have hooks, those which have hooks throughout their lives, and those with deciduous hooks. To use the absence of hooks in a few individuals, by itself, to establish a new species would be a mistake.

2. Tentacles.—Most members of this genus have one of two general types of tentacular arrays. About half the species have a 'normal' crown of flattened, digitate tentacles (more than 10, number increasing with age, Fig. 2A), while the other half have few (eight or less) short, lobate tentacles. Often these latter species exhibit only two tentacles plus four to six small lobes (Fig. 2B). There are two with unique arrangements (see *N. novaezealandiae* and *N. rutilofuscum,* Fig. 2C, D). In summary, this character can be helpful if it can be seen. A major problem is that most preserved specimens do not have their introverts extended and it is very difficult accurately to interpret the morphology of these structures in dissected material, especially since most have introverts less than 0.5 mm in diameter.

3. Caudal appendage.—This is an easily seen character. It is best exhibited in *N. flagriferum* as a thin, rat-like tail. In *N. bulbosum* it is less clearly set off and more like a narrowed tapered portion of the trunk, not an appendage. The posterior end of the trunk

in the other species may form a conical point (like a blunt pencil) but not a tail.

4. Trunk length to width ratio.—These species fall into two general groups; elongate, slender worms (trunk length more than 10 times the width) and the shorter, stouter worms (length less than 6–8 times the width). Due to the ontogenetic or elastic properties of these worms there may be wide variation in this ratio. One must also be sure the trunk one is measuring has not been damaged/truncated. Except in a very general way, this measurement is of minimal value to the taxonomist and can be misleading if interpreted too narrowly.

5. Introvert length.—This body region ranges from $\frac{1}{5}$ (in *N. constricticervix*) to twice the trunk length in a few species. Most species have introverts shorter than the trunk (0.4–0.8×). When the introvert is retracted or only partially extended, this measurement will be shorter than it would be if the introvert was completely extended due to its extreme elasticity. This character can have limited usefulness if accurately determined. Some confusion has resulted from how this measurement is made. Our practice is to use the nephridiopores to mark the anterior end of the trunk so that anything anterior to this point is considered introvert (in taxa where the anus is anterior to the nephridiopores the anus is used instead). Earlier authors have been less explicit and therefore one cannot be certain what they considered to be the introvert. Another often overlooked issue is an ontogenetic one. It is clear that the trunk grows faster than the introvert, so that as a worm ages, the introvert appears to get shorter, i.e., represent a smaller fraction of the total length (see Appendix).

6. Anus/nephridiopores relationship.—The middorsal anus usually is located at the anterior end of the trunk as are the pair of ventrolateral nephridiopores. There may be a small but measureable difference in the relative position of these openings. The nephridiopores are at essentially the level of the anus in most species in this genus. In six species these pores are anterior to the anus, commonly by 3–10% of the trunk length (see *N. flagriferum* in Appendix). Seven species are reported to have their nephridiopores posterior to the anus. In small worms where this distance is less than 1 mm the decision is subjective as to whether or not they are at the same level. This can be a useful character for some species.

7. Papillae distribution, size, and shape.—As with other genera these secretory organs are more concentrated and larger at the two ends of the trunk, sparser and smaller in the center. There are two basic morphs in these taxa; most species have low, inconspicuous 'skin bodies.' There are only a few species with well developed, obvious, mammiform papillae. The shape of these structures, when present, is quite variable and should not be considered taxonomically useful. It seems likely that a genetic potential for producing papillae exists and the degree to which this is expressed is determined by the nature of the microhabitat an individual occupies, i.e., analogous to human calluses.

8. Shields.—This term has caused much confusion within this phylum. In the Aspidosiphonidae there is a hardened epidermal structure (calcium or scleroprotein?) at the anterior end of the trunk (sometimes posterior also). This same term has been used to describe a very different situation in this genus, i.e., an aggregation of close-packed papillae around the distal ends of the trunk giving it a dark, rugose appearance. This condition is very different from a shield as used in other genera and the use of this term is misleading and should not be used in this taxon. These epidermal papillae may be gathered into longitudinal ridges and darkly pigmented (e.g., *N. vitjazi* or *N. wodjanizkii*). In addition, under certain conditions, the anterior end of the trunk is pulled in to give a flattened appearance accentuating this pseudoshield morph.

9. Spindle muscle.—In most sipunculans there is a thin thread-like muscle running through the gut coil and connecting to it at intervals. In some genera it extends through

and out of the posterior end anchoring the coil to the posterior end of the trunk. In many, it extends out of the anterior end of the coil, along the rectum, and attaches to the body wall just anterior to the anus. However, there are several variations on this theme. In *Nephasoma* the muscle does not extend beyond the posterior end of the coil and in most species it does not extend beyond the anterior end either. In a few species one can see the muscle coming out the anterior end but it quickly terminates on the wall of the rectum. In a few (e.g., *N. flagriferum*) this muscle is well developed, sometimes branching, and extends from the rectum on to the body wall near or anterior to the anus. In a few species (e.g., *N. abyssorum, N. lilljeborgi*) one can rarely find any trace of the spindle muscle. One does find variation within a population (see *N. constrictum* in Appendix) and in small worms it is very difficult to find, even when present. Therefore, the taxonomic value of this character is limited as most species have a similar condition, it is not well developed in small individuals, and it is not consistently present within a population so that its apparent absence in an individual can be misleading.

10. Retractor muscles' point of origin.—The muscles that insert behind the 'head' and function to retract the introvert have their origins on the inner surface of the trunk wall. The position of this attachment along the anterior/posterior axis has been assumed to be of value. The most common condition is for these muscles to originate between 30–70% of the distance towards the posterior end of the trunk. Within a species this relative position may vary as the worm increases in size (appearing to move anteriad with an increase in trunk length, see Appendix). There are four species having these origins in the 15–30% range (*N. constricticervix, N. novaezealandiae, N. tasmaniense, N. vitjazi*) and three with their origins between 75–90% of the distance to the posterior end of the trunk (*N. filiforme, N. rutilofuscum, N. wodjanizkii*).

11. Intestinal coiling.—Most species have a tightly wound double helix but some of the elongate, slender species have this helix stretched out or loosely wound with space between the individual coils easily seen. This coiling seems to be a constant difference. What is not constant is the number of coils. This is clearly correlated to the size of the animal and not a species–specific character (see Appendix; also Ditadi and Migotto 1981).

12. Intestinal fixing muscles.—The number of fine, thread-like muscles attaching the gut coil to the body wall varies from 0–7 according to published accounts. This has been alleged to be a species–specific character but our experience suggests that A: these are very fragile structures and can be easily broken, and B: these are easily overlooked and even if present not mentioned by certain authors, and C: The number of muscles within one population does vary (see Appendix). In a population of 52 *N. confusum* examined by Ditadi and Migotto (1981) most had five of these muscles but the range was one to seven. Therefore, we place very little weight on this feature.

13. Rectal caecum.—This is not a useful character for two reasons. Given the small size of many of these worms and the difficulty of dissection, even if it was present it could be easily overlooked. Many authors simply do not mention its presence or absence. Also, in populations where this is present some individuals may lack it—which does not exclude the individual from this species; there is variation. However, there are species which consistently lack one (*N. constrictum*) while others seem to consistently have one (*N. flagriferum*) so in a few particular cases it may be helpful as a diagnostic character.

Key to *Nephasoma* Species

1. Posterior end of trunk with caudal appendage (tail) 2
– Posterior end of trunk rounded or bluntly pointed 3

2. Posterior end of trunk with large papillae, and tail thin, whiplike .. .. *N. flagriferum*
– Posterior end of trunk without large papillae, and tail formed from narrowed portion of trunk .. *N. bulbosum*
3. Trunk rusty-red .....*N. rutilofuscum*
– Trunk white, yellow, or brown; not red 4
4. Trunk with obvious, pigmented, raised papillae 5
– Trunk may have papillae (skin bodies) but these are unpigmented and barely raised above the surface 7
5. Tentacles present, papillae uniformly distributed all over trunk, trunk length rarely exceeds width by more than 8 times (stout cylinder or flask shaped), shallow to bathyal depths 6
– Tentacles reduced to lobes, papillae rare in midtrunk, trunk length commonly exceeds width by more than 8 times (slender cylinder), deep, cold water .. *N. diaphanes*
6. Trunk flask shaped, anus on narrowed anterior region which usually also exhibits an indented constriction, nephridia posterior to the anus ..... *N. constrictum*
– Trunk sausage shaped, nephridia not posterior to anus .. *N. pellucidum*
7. Elongate, very slender transparent trunk, sometimes threadlike (trunk width usually less than $1/10$ the length), gut with separated coils and no spindle muscle 8
– Cylindrical translucent or opaque trunk (trunk width rarely less than $1/10$ the length), gut coils close together, spindle muscle usually present 13
8. About 30 dark longitudinal epidermal ridges at anterior end of trunk sometimes giving the impression of a hardened pseudoshield 9
– Anterior end of trunk without dark epidermal ridges 10
9. Retractor muscles originate in anterior $1/3$ of trunk, introvert less than $1/3$ trunk length, distal hooks over 150 μm ..... *N. vitjazi*
– Retractor muscles originate in posterior third of trunk, introvert $1/2$–7 times the trunk length, distal hooks less than 25 μm .... *N. wodjanizkii*
10. Anterior end of trunk in shape of short cone with epidermal ridge around base of cone (Fig. 3C) ... .*N. tasmaniense*
– Anterior end of trunk not cone shaped but often swollen around nephridiopores 11
11. Introvert longer than trunk (Fig. 3A), retractor muscles originate from 35–50% of distance to posterior end, hooks less than 30 μm .....*N. capilleforme*
– Introvert shorter than trunk, retractor muscles originate from 15–30% of distance to posterior end, distal hooks more than 100 μm 12
12. Introvert less than 25% trunk length, distal hooks exceed 200 μm ..... *N. constricticervix*
– Introvert 50–75% trunk length (Fig. 3B), distal hooks 150 μm or less .. .. *N. cutleri*
13. Hooks in distinct rows around introvert ..... *N. rimicola*
– Hooks, if present, not in rings .. 14
14. Hooks with unusual series of radiating filaments from base (Fig. 1C) .....*N. multiaraneusa*
– Hooks, if present, without basal filaments 15
15. Retractor muscles originate in posterior $1/4$ of trunk ..... *N. filiforme*
– Retractor muscles originate in middle $1/3$ of trunk 16
16. Tentacular crown reduced to short lobes, dorsal pair largest 17
– Normal array of digitiform tentacles present 19
17. Hermaphroditic species from shallow, Northeastern Atlantic Ocean,

trunk length usually 4–5× diameter ..... *N. minutum*
– Dioecious species, trunk length 6–10× diameter 18
18. Larger, opaque, from bathyal depths ..... *N. lilljeborgi*
– Smaller, transparent/translucent, bathyal and abyssal depths ..... *N. diaphanes*
19. Medium sized (more than 50 μm) dark hooks present 20
– Hooks apparently absent 22
20. Hooks in spiral arrangement, unique shape (Fig. 1F) *N. abyssorum*
– Hooks scattered 21
21. Hooks robust and blunt (Fig. 1D) ..... *N. confusum*
– Hooks tall, spinelike with soft cortical layer (Fig. 1A) *N. laetmophilum*
22. Less than 50 digitiform tentacles, introvert 1–2 times trunk length .. .. *N. eremita*
– More than 50 threadlike tentacles, introvert less than ½ trunk length ..... *N. novaezealandiae*

Taxonomic Section

This section has those species we consider to be valid arranged alphabetically. Following this is a section including the species placed in incertae sedis, species inquirendum or moved to other genera (see Table 1).

Nephasoma abyssorum (Koren and Danielssen, 1875)

Phascolosoma abyssorum Koren and Danielssen, 1875:129–130.—1877:131–132.—Selenka et al., 1883:30–31.—Fischer, 1895:14; 1925:16; 1929:471–472.—Théel, 1905:78.—Gadd, 1911:88–89.—Southern, 1913:27–28.—J. Fischer, 1914:99–100.—Wesenberg-Lund, 1933: 9–11.

Phascolosoma abyssorum var. *punctatum* Herubel, 1925:261–262.

Golfingia abyssorum.—Wesenberg-Lund, 1955:201.—Murina, 1964a:220–221; 1964b:56–57; 1968:195.—Stephen and Edmonds, 1972:134–135.—Cutler and Cutler, 1980b:452.—Gibbs, 1982:121.—Cutler et al., 1984:268–269.—Saiz-Salinas, 1984:182–183.

Not *Physcosoma* (=*Phascolosoma*) *abyssorum* Southern 1913:12.

Phascolosoma incompositum Sluiter, 1912: 16–17, pl. 1, figs. 9–10.

Golfingia incomposita.—Stephen and Edmonds, 1972:145–146.

Nephasoma incompositum.—Gibbs, 1986: 339–340.

Material examined.—*N. abyssorum*: ZMUB, type; other recently collected North Atlantic specimens. *G. incomposita*: ZMUA, type. *G. benhami*: BMNH, type.

In general shape and appearance (smooth, white, sometimes iridescent trunk) this species resembles *N. lilljeborgi* and *N. minutum.* It is distinguished by having developed tentacles and unique, spirally arranged, medium-sized, dark hooks (50–150 μm). While this species is alleged to lack a spindle muscle we did observe a weakly developed muscle within the gut coil in two out of eleven specimens closely examined.

Herubel (1925) described a variety (*P. a. punctatum*) which Stephen and Edmonds (1972) elevated to subspecific rank. Since the reference material cannot be located and the putative difference (small elliptical papillae scattered thinly over the trunk) is so slight, we have reduced this taxon to the status of a junior synonym of the nominate form.

The single specimen of *N. incompositum* has the iridescent skin, dark recurved hooks and bathymetric range of *N. abyssorum.* Therefore, we concur with Gibbs (1986) in reducing it to the status of a junior synonym.

Distribution.—Common in northeast Atlantic and Arctic oceans, rare in northwest Atlantic and Pacific oceans, and Mediterranean Sea at bathyal and abyssal depths.

Table 1.—Species considered and proposed taxonomic changes.

Present name	Proposed name
Nephasoma abyssorum (Koren and Danielssen, 1875)	No change
Nephasoma benhami (Stephen, 1948)	*N. abyssorum benhami*
Nephasoma bulbosum (Southern, 1913)	No change
Nephasoma capilleforme (Murina, 1973)	No change
Nephasoma chuni (Fischer, 1916)	incertae sedis
Nephasoma cinctum (Gerould, 1913)	*N. diaphanes diaphanes*
Nephasoma cinereum (Gerould, 1913)	*N. pellucidum pellucidum*
Nephasoma confusum (Sluiter, 1902)	No change
Nephasoma constrictum (Southern, 1913)	No change
Nephasoma constricticervix (Cutler, 1969)	No change
Nephasoma cutleri (Murina, 1975)	No change
Nephasoma delagei (Herubel, 1903)	incertae sedis
Nephasoma depressum (Sluiter, 1902)	species inquirendum
Nephasoma diaphanes (Gerould, 1913)	*N. diaphanes diaphanes*
Nephasoma elachea (Fisher, 1952)	*N. eremita*
Nephasoma elisae (Murina, 1977)	*N. wodjanizkii elisae*
Nephasoma eremita (Sars, 1851)	No change
Nephasoma filiforme (Sluiter, 1902)	No change
Nephasoma fimbriatum (Sluiter, 1902)	species inquirendum
Nephasoma flagriferum (Selenka, 1885)	No change
Nephasoma glacialis (Koren and Danielssen, 1880)	*N. lilljeborgi*
Nephasoma improvisa (Théel, 1905)	*N. minutum*
Nephasoma incompositum (Sluiter, 1912)	*N. abyssorum*
Golfingia intermedia (Southern, 1913)	*Phascolion strombus*
Nephasoma laetmophilum (Fisher, 1952)	No change
Nephasoma lilljeborgi (Danielssen and Koren, 1880)	No change
Golfingia macra (Sluiter, 1891)	*Aspidosiphon macer*
Nephasoma marinki Pergament, 1940	*N. lilljeborgi*
Nephasoma minutum (Keferstein, 1863)	No change
Nephasoma mucidum (Sluiter, 1902)	*N. filiforme*
Nephasoma multiaraneusa (Murina, 1967)	No change
Nephasoma nicolasi (Thompson, 1980)	*N. wodjanizkii wodjanizkii*
Nephasoma novaezealandiae (Benham, 1904)	No change
Golfingia pavlenkoi (Ostroumov, 1909)	*Thysanocardia nigra*
Nephasoma pellucidum (Keferstein, 1865)	*N. pellucidum pellucidum*
Nephasoma prioki (Sluiter, 1881)	*Thysanocardia nigra*
Nephasoma rimicola (Gibbs, 1973)	No change
Nephasoma rutilofuscum (Fischer, 1916)	No change
Nephasoma schuttei (Augener, 1903)	No change
sensu Cutler and Murina	*N. diaphanes corrugatum*
Nephasoma sluiteri (tenBroeke, 1925)	*N. pellucidum pellucidum*
Nephasoma subhamatum (Sluiter, 1902)	*N. pellucidum subhamatum*
Nephasoma tasmaniense (Murina, 1964)	No change
Nephasoma verrilli (Gerould, 1908)	*N. pellucidum pellucidum*
Nephasoma vitjazi (Murina, 1964)	No change
Nephasoma vitreum (Roule, 1898)	incertae sedis
Nephasoma wodjanizkii (Murina, 1973)	*N. wodjanizkii wodjanizkii*

Nephasoma abyssorum benhami (Stephen, 1948), new status

Phascolosoma benhami Stephen, 1948:218–219, pl. 1, figs. 2–4.
Golfingia benhami.—Stephen and Edmonds, 1972:135–136.

The two bathyal Antarctic specimens of *G. benhami* are said to be similar to *N. lilljeborgi* differing only in papillae and hook size. However, our examination showed a much greater similarity to *N. abyssorum* with its larger, dark hooks and 'normal' tentacles. Stephen measured the body regions in the holotype from a point about 3 mm anterior to the nephridiopores. If one uses these pores to mark the anterior end of the trunk then the retractors are in the middle third, not posterior. The two specimens are 13 mm and 22 mm long. The presence of a spindle muscle within the gut coil (not extending out onto the rectum) and its location (no records of *N. abyssorum* in the southern latitudes) rule against combining these two taxa. Therefore, we have retained the name but reduced it to the rank of a geographically separated subspecies whose major morphological distinction is a strongly developed spindle muscle.

Distribution.—Off Kemp Land, Antarctica 600 m.

Nephasoma bulbosum (Southern, 1913)

Phascolosoma bulbosum Southern, 1913: 23–24, pl. 5, fig. 6.
Golfingia bulbosa.—Stephen and Edmonds, 1972:136.—Cutler, 1973:152–153.
Nephasoma bulbosum.—Gibbs, 1986:337.

Material examined.—INMD, Type material.

This taxon is similar to *N. flagriferum* in having a tail and papillae on the posterior end of the trunk but in both cases they are very much smaller in this species. The tail is not really a caudal appendage but more a narrowing of the trunk into a point. The nerve cord extends into the distal tip of this tail unlike the condition in *N. flagriferum*. Aside from the shape of the body this species is like *N. eremita* in many ways, including the apparent absence of hooks, and may be closely related.

Distribution.—Off Ireland and northeast United States at bathyal depths.

Nephasoma capilleforme (Murina, 1973)

Golfingia capilleformis Murina, 1973a:943–944.—Frank, 1983:14–15.
Golfingia glacialis.—Murina, 1964b:57–59; 1974a:234.—Cutler and Cutler, 1980b: 453–454.

Material examined.—ZIAS, Type material and other specimens identified by Murina; recently collected Atlantic Ocean worms.

This is one of the group of thin deep-water species with loosely wound gut coils. When present and extended the long introvert (1–2 times the trunk) and small hooks (20–25 μm) are diagnostic. In general this has the most elongate thread-like body of the genus and it is often irregularly contracted to give a beaded appearance. The anterior end of the trunk often is swollen and golden colored in the vicinity of the anus and nephridiopores.

Distribution.—Pacific and Atlantic oceans from 920–4900 m.

Nephasoma confusum (Sluiter, 1902)

Phascolosoma confusum Sluiter, 1902:38–39, pl. 3, fig. 5.
Golfingia confusa.—Murina, 1957:993–994; 1972:298–299; 1974a:234; 1978:123.—Stephen and Edmonds, 1972:138–139.—Cutler and Cutler, 1980c:199–200.—Ditadi and Migotto, 1981:125–134.—Cutler et al., 1984:269.
Golfingia confusa zarenkovi Murina, 1974b: 1716–1717, fig. 3.

Material examined.—ZMUA, Type specimen; 2 specimens from Japan; ZIAS, Murina's subspecies holotype.

This species has been redescribed in detail by Ditadi and Migotto (1981) on the basis of 106 specimens ranging in length from 2.5–25 mm. The scattered hooks are medium sized (up to 90 μm) and have a distinctive rim of reinforcing chitin. The skin lacks papillae but does have round skin bodies. In their paper Ditadi and Migotto (1981: 131–132) compare this species to *N. cinereum* but it is our belief, based on an examination of the type, that their interpretation of the papillae/skin bodies and hooks was in error. *Nephasoma cinereum* does not have this type of hook and does have distinct papillae. Therefore, following the lead of Cutler and Murina (1977) we consider it to be a junior synonym of *N. pellucidum.*

Murina's subspecies was described from two specimens of 4 mm and 5 mm. The supposed differences from the nominate form are due to its small size and these individuals do not warrant subspecific rank.

Distribution.—Around the Antarctic, off Brazil, southern Australia, Indonesia, and the northwest Pacific Ocean from 4–4600 m.

Nephasoma constrictum (Southern, 1913)

Phascolosoma constrictum Southern, 1913: 25–27, pl. 6, fig. 7.

Golfingia constricta.—Stephen and Edmonds, 1972:139.

Nephasoma constrictum.—Gibbs, 1986: 337.

Material examined.—INMD, Type specimens; several recently collected specimens from near the type locality.

This species shares many attributes with *N. pellucidum* but differs most notably by the flask-shaped trunk, short stubby tentacles and the constriction at the introvert/trunk junction. The Appendix contains morphological information on 17 worms ranging in trunk length from 7–30 mm. The known distribution is distinct and limited.

Distribution.—Off Ireland at 1100–1300 m plus unpublished records in northeastern Atlantic (35–51°N) at 1900–4000 m.

Nephasoma constricticervix (Cutler, 1969)

Golfingia constricticervix Cutler, 1969:215–217; 1973:153.—Cutler and Cutler, 1980b:452; 1980c:200.

Material examined.—Type material plus several recently collected specimens.

This is one of two species in this genus which has hooks exceeding 200 μm. It is one of several elongate, slender deep-water members of this genus and if the introvert is withdrawn or broken off it can be difficult to identify with certainty (see discussion of *N. cutleri*). The range in hook size is from 40–250 μm and only the more distal hooks exceed 200 μm. Therefore, if only the smaller hooks are seen it is possible to mistake this for another species e.g., *N. cutleri.*

Distribution.—North Atlantic at 1500–5500 m. Unpublished records extend this to 22°S in the eastern Atlantic.

Nephasoma cutleri (Murina, 1975)

Golfingia cutleri Murina, 1975:1087–1088; 1978:123.

Material examined.—ZIAS, Type material.

On paper this species has many similarities to *N. constricticervix.* However, the hooks are considerably smaller (less than 150 μm) and paler, the introvert is longer (50–75% of the trunk length, not 20–25%) and the worm is much less robust. This species has only been recorded from the Pacific Ocean while the other appears to be an Atlantic Ocean species.

Distribution.—Pacific Ocean from 40°S–11°N at abyssal depths.

Nephasoma diaphanes diaphanes (Gerould, 1913)

Phascolosoma diaphanes Gerould, 1913: 395.

Golfingia diaphanes.—Cutler and Cutler, 1980b:452–453; 1980c:201–202.—Frank, 1983:15–16.—Cutler et al., 1984:269–270.

Phascolosoma improvisum.—Gerould, 1913:395–396.—Wesenberg-Lund, 1930: 32–34; 1939:22–23.
Golfingia improvisa.—Wesenberg-Lund, 1955:11; 1963:110–111.—Murina, 1958: 1625–1628; 1968b:197; 1971b:42; 1972: 300; 1973b:69; 1978:123.—Stephen and Edmonds, 1972:145.—Amor, 1975:113–115.—Edmonds, 1976:222–224.
Phascolosoma minutum.—Théel, 1911: 31.—Sluiter, 1912:10–11.—Fischer, 1922a:34; 1922b:237; 1929:464–467 (partim).—Wesenberg-Lund, 1930:30; 1932:9–10; 1937a:9–10; 1937b:12–13.
Golfingia minuta.—Wesenberg-Lund, 1955: 11; 1963:110–111.—Murina, 1957:994–995; 1958:1628–1634; 1968b:197; 1971b: 42; 1972:300; 1973b:69; 1974a:235; 1976:65; 1978:124.—Stephen and Edmonds, 1972:149–150.—Cutler, 1973: 155–159; 1977a:143.—Cutler and Cutler, 1979a:957–958.—Saiz-Salinas, 1984:183.
Golfingia sectile Murina, 1974a:228–230.
Phascolosoma anceps.—Sluiter, 1912:10.—Wesenberg-Lund, 1925:90.
Phascolosoma cinctum Gerould, 1913:398–400, pl. 59, fig. 6, text–fig. 8.
Golfingia cincta.—Stephen and Edmonds, 1972:137–138.
Phascolosoma sabellariae.—Gerould, 1913: 392–395.

Material examined.—USNM #8584, Gerould's other material, *G. cincta* type; hundreds of specimens from the East Coast of North America; ZIAS, type specimen of *N. sectile.*

As noted in the introduction to this section this taxon is very similar to *N. minutum* and *N. lilljeborgi* but is generally small (less than 10 mm), with a transparent/translucent body wall, cosmopolitan in deep water, and dioecious. Gerould (1913) first suggested using the name *diaphanes* for the western North Atlantic animals that matched the description of *P. minutum* but were not hermaphroditic (he used the name *Phascolosoma sabellariae* for that collection). However, it was not until Cutler and Cutler (1980c:201) that this idea was discussed, adopted, and the name *G. diaphanes* was formally used. We recently examined Gerould's specimens of *P. sabellariae* which now serve as the type series for this species and selected one sample for a lectotype.

The single *N. sectile* from 6200 m in the South Atlantic is not as slender as most members of this species (1.6 × 6.7 mm) but is within the range of possible variation and does not exhibit any unique set of features. Thus, we consider it to be a junior synonym of this species. In Cutler (1973) *G. cincta* was placed in synonymy with *G. minuta* but since the recent redefinition of the latter, *G. cincta* must now be considered a junior synonym of this species.

Distribution.—Cosmopolitan, cold water, most from bathyal and abyssal depths.

Nephasoma diaphanes corrugatum, new subspecies

Golfingia schuttei.—Murina, 1964a:238–242; 1967c:54; 1971a:81; 1971b:43; 1973b:69–70; 1974a:235; 1978:124.—Cutler and Cutler, 1980b:453; 1980c: 204.—Frank, 1983:17–18.

Description.—These pear- to cylindrical-shaped animals have trunks up to 10 mm long (occasionally up to 30 mm). The skin is tan to greyish-brown, translucent to opaque, with irregular, longitudinal epidermal ridges (wrinkles or folds) commonly on the base of the introvert and the anterior part of the trunk (occasionally extending to the posterior end). Often there are papillae on the posterior end which may be darker than the surrounding skin. The introvert is about equal in length to the trunk but may vary from 50–150% of the trunk length, and bears small (usually 20–30 μm tall), scattered, pale, triangular hooks. The tentacular crown is reduced to a few (6–8) short lobes plus two longer dorsal tentacles similar to that in *N. minutum.*

Internally the ventral pair of introvert re-

tractor muscles originate near the posterior end (75–85%) in small worms (less than 4 mm) but in the middle (50–70%) in larger ones. The pair of short free nephridia are at the level of, or just posterior to, the anus. The gut forms a double helix with a weakly developed spindle muscle within the coil, not extending onto the rectum. No fixing muscles or caeca were seen.

Differential diagnosis.—The main difference from the nominate form is the nature of the epidermis, this one having rough, opaque skin with wavy ridges, *N. diaphanes diaphanes* having smoother, translucent/transparent skin, although some do have raised, pigmented papillae, especially on the posterior third. The subspecific name reflects its ridged epidermal appearance.

Type material.—Deposited at the National Museum of Natural History (USNM) Washington, D.C., holotype USNM 98775, 10 paratypes USNM 98776.

Remarks.—This subspecies is not well defined and future systematists using other characters may reach different conclusions. The use of the name *N. schuttei* in the several works by Cutler and Murina listed in the synonymy is the result of looking at the original description and interpreting it too broadly. The deep waters of the world's oceans are densely populated with small members of this genus which have been intensively collected over the past two decades. A dependable and universally applied classification of this fauna is desirable, but not yet in our hands.

Distribution.—Atlantic and Pacific oceans and the Mediterranean and Red seas from 80–5900 m.

Nephasoma eremita (Sars, 1851)

Sipunculus eremita Sars, 1851:197.

Sipunculus (*Phascolosomum*) *borealis* Quatrefages, 865:620.

Phascolosoma boreale Keferstein, 1865: 437–438.—Baird, 1868:84.—Diesing, 1851:555; 1859:760.—Verrill, 1874: 387.—Koren and Danielssen, 1877:134.

Phascolosoma digitatum Théel, 1875:11; 1905:72.

Phascolosoma eremita.—Selenka et al., 1883:35–36.—Fischer, 1895:17; 1914:10; 1922b:237; 1925:17; 1929:463–464.—Théel, 1905:72–74.—Gadd, 1911:88.—Sluiter, 1912:8.—Gerould, 1913:385–387.—J. Fischer, 1914:98–99.—Chamberlain, 1920:4.—Wesenberg-Lund, 1930: 28; 1932:67; 1937b:11–12.—Leroy, 1936: 425.

Golfingia eremita.—Stephen and Edmonds, 1972:141–142.—Cutler, 1973:150–152.—Cutler and Cutler, 1980a:1–2; 1980c:202–204.—Frank, 1983:16–17.

Phascolosoma eremita australis Benham, 1922:17–18.—Fischer, 1929:483.

Golfingia eremita var. *australe.*—Wesenberg-Lund, 1963:111.—Stephen and Edmonds, 1972:14.—Murina, 1972:299–300; 1974a:234.—Not Wesenberg-Lund, 1959:182–183.

Golfingia eremita californica Fisher, 1952: 396–397.—Stephen and Edmonds, 1972: 142.

Phascolosoma eremita scabra Gerould, 1913:387–388.

Golfingia eremita scabra.—Stephen and Edmonds, 1972:142.

Golfingia elachea Fisher, 1952:399–400, pl. 25, figs. 1–3.

Material examined.—USNM, types of *G. eremita californica, G. eremita scabra, G. elachea*; MNHU, *P. boreale* type; recently collected North Atlantic specimens.

This species appears to be one of the few members of this genus to lack hooks. However, as pointed out earlier, if only the young worms do have hooks (as has been shown for other members of this phylum) they probably would be identified as some other species. A study of the early life stages of this species would be most valuable. Mature worms have a stocky nonpapillated trunk, often with transverse grooves in the thick body wall, and the tentacles are well developed.

Fisher's single example of *N. elachea* from Baja California presumably differs from this species because it has seven fixing muscles. The present condition of the type precludes any confirmation of this. Fisher did not provide a differential diagnosis but did put this item in italics thereby stressing its importance to him. The number of fixing muscles is quite variable throughout this phylum and especially within this genus. We see no real differences here and therefore consider *G. elachea* to be a junior synonym.

The three subspecies listed in Stephen and Edmonds (1972) are not considered by us to merit such rank and are hereby reduced to junior synonyms. We reaffirm Cutler's (1973) observations about Gerould's dark variety *scabra* being an environmentally (not genetically) determined attribute. Benham's (1922) variety *australis* was based on a single worm and the primary distinction was the distribution and relative size of the papillae, not a solid basis. Fischer's (1929) record was simply a repeat of Benham's, not new material. Fisher's (1952) variety *californica* has a 'strong' spindle muscle and no functional contractile vessel. Our comparison of this material showed these structures to be near one end of their particular continuum but not outside the range found in Atlantic populations.

Distribution.—Common in the Arctic and North Atlantic, present in South Atlantic and Antarctic, rare in the eastern Pacific Oceans from 20–2000 m.

Nephasoma filiforme (Sluiter, 1902)

Phascolosoma filiforme Sluiter, 1902:37–38, pl. 4, figs. 1–4.
Golfingia filiformis.—Stephen and Edmonds, 1972:143.
Phascolosoma mucidum Sluiter, 1902:40.
Golfingia mucida.—Stephen and Edmonds, 1972:150.

Material examined.—ZMUA, Type material of *N. filiforme* and *N. mucidum.*

The three *N. filiforme* specimens vary more than the description suggests, especially in the form of their papillae on the two ends of the trunk. Only one of these has long hairlike papillae on the front end and the mushroomlike form of the posterior papillae is an oversimplification. One additional problem concerns the location of the anus and nephridiopores. Thompson (1980) said that these openings were on the introvert and Sluiter reported the introvert length to be half that of the trunk. This confusion results from the fact that the circular muscles in the anterior part of the trunk and the proximal part of the introvert have contracted in an atypical fashion. This situation has been the cause for confusion in *N. marinki* also (see Cutler and Murina 1977). Our operational definition of the trunk/introvert junction being that region just anterior to the nephridiopores resolves this problem so that the trunk is 40 mm long (not 60) with an introvert 1.2 times longer in this worm. In the other two type specimens (trunk lengths 15 mm and 45 mm) the introvert is about 0.8 and 0.3 times the trunk length, hardly a constant species-specific character. This is not a solidly based species and needs some clarification and a larger data base but we propose no changes at this time.

There are also some problems with *N. mucidum.* Our measurements of the two remaining specimens showed their length (6 mm and 7 mm) exceeds their width by only three times, not 10. It is clear that these specimens are damaged and incomplete so these measurements are of limited value. The long papillae Sluiter mentioned are very few in number. The grey felt-like covering does not seem to be a part of the animal but rather some adhering substrate and very easily rubbed off. These animals came from the same location and we see no significant differences. Since *N. mucidum* appears later in the publication it becomes the junior synonym.

Distribution.—Off Indonesia (6°S, 134°E) at 1788 m.

Nephasoma flagriferum (Selenka, 1885)

Phascolosoma flagriferum Selenka, 1885: 13–16, pl. 3, fig. 17.—Sluiter, 1900:12.—Fischer, 1914:10.—Gerould, 1913:391–392.

Golfingia flagrifera.—Murina, 1968b:196; 1978:123.—Stephen and Edmonds, 1972: 144.—Cutler, 1973:153–155; 1977a:142–143.—Cutler and Cutler, 1980b:453.

Material examined.—BMNH, Type specimen; many recently collected specimens.

The large vesicular, bulbous papillae on the posterior end of the trunk and the distinct caudal appendage make this species easy to identify and there is no confusion about its validity. The Appendix contains morphological information on 27 worms ranging in trunk length from 3.5–120 mm.

Distribution.—An abyssal species (few bathyal records) common in the North Atlantic, present in the South Atlantic and Pacific.

Nephasoma laetmophilum (Fisher, 1952)

Golfingia laetmophila Fisher, 1952:397–399, pl. 25, figs. 4–6.—Stephen and Edmonds, 1972:148.

Material examined.—USNM, Type specimen.

This single bathyal California specimen has many characters in common with the Atlantic Ocean *N. abyssorum*. The larger number of tentacles (40) and the strong wing muscle may be important or may be artifacts of its larger size. The one striking difference is the nature of the hooks; they have a spine-like form with a cortical layer which can be easily rubbed off. Whether this single specimen is an anomaly or part of a biological population is an open question. It is puzzling why no additional specimens from this heavily sampled region have been recovered in the intervening decades. Despite our reservations we propose no change in the status of this species at this time.

Distribution.—Off southern California, 1900 m.

Nephasoma lilljeborgi
(Danielssen and Koren, 1880)

Phascolosoma lilljeborgii Danielssen and Koren, 1880:463–464; 1881:63–64.—Selenka et al., 1883:40–41.—Fischer, 1895: 14; 1929:471–472.—Sluiter, 1912:9.—Théel, 1905:79–80.

Golfingia lilljeborgi.—Wesenberg-Lund, 1954:9–10.—Stephen and Edmonds, 1972:148.—Gibbs, 1982:121–122.—Frank, 1983:17.

Onchnesoma glaciale Danielssen and Koren, 1880:464; 1881:64.

Phascolosoma glaciale.—Roule, 1896: 474.—Théel, 1905:80–81.—Fischer, 1929:472.—Wesenberg-Lund, 1930:30; 1932:8–9.

Golfingia glacialis.—Stephen and Edmonds, 1972:144.—Gibbs, 1982:119–120.—Not Murina, 1964b: 57–59; 1974a: 234.—Cutler and Cutler, 1980b:453–454.

Nephasoma marinki Pergament, 1940:55–61.—Stephen and Edmonds, 1972:214–215.

Material examined.—ZMUB, Type specimens of *N. lilljeborgi* and *N. glaciale*; other recently collected specimens from near the type-locality.

This taxon has recently been revised by Gibbs (1982). On paper there is very little to differentiate this taxon from *N. diaphanes*. The type material is larger (10–30 mm), more opaque, does not live in foraminiferan tests as many *N. diaphanes* do, and was collected from shallower water. The posterior end of the trunk in many worms comes to a blunt point or has a posterior nipple on a rounded base. This name has only been used a few times and only for specimens collected in the northeast Atlantic Ocean. *Nephasoma marinki* was synonymized in Cutler and Murina (1977). Since the recent reevaluation of this species it has been determined

that Cutler and Murina had used this name for some *N. capilleforme*.

Distribution.—Far northeast Atlantic Ocean from bathyal depths.

Nephasoma minutum (Keferstein, 1863)

?*Sipunculus johnstoni* Forbes, 1841:254.
Phascolosoma johnstoni.—Southern, 1913: 28.—Lindroth, 1941:449–450.
Phascolosoma minutum Keferstein, 1863: 40, pl. 3, figs. 7–10; 1865:438.—Cuenot, 1922:9–10.—Fischer, 1925:19–20; 1929: 464–467(partim).—Wesenberg-Lund, 1939:20–22.—Stephen, 1934:167–168.
Petalosoma minutum.—Selenka et al., 1883: 129.—Southern, 1908:83–86.—Paul, 1909:1–50.
Golfingia minuta.—Åkesson, 1958:33–46.—Stephen and Edmonds, 1972:149–150.—Gibbs, 1973:73–86; 1975:69–82; 1977a:16–17.
Phascolosoma anceps Théel, 1905:84–86.—Wesenberg-Lund, 1925:90.
Phascolosoma improvisum Théel, 1905:82–83, pl. 5, figs. 51–58, pl. 12, figs. 177–178, pl. 14, figs. 202–203.—Wesenberg-Lund, 1939:22–23.
Golfingia improvisa.—Stephen and Edmonds, 1972:145.
Phascolosoma sabellariae Théel, 1905:81.

Material examined.—Several recently collected specimens identified by P. Gibbs collected near the type locality.

This name has been used in a variety of ways over the past century. Gibbs (1977a: 79–80) has been the most recent to examine this situation and he redefined the taxon in a narrow way including only those from shallow water in the northeastern Atlantic Ocean which are hermaphroditic (see also Paul 1910 and Åkesson 1958). It is often very difficult to differentiate between several populations as discussed in the introduction and it is likely that very often this name has been used as a taxonomic wastebasket. The present definition still includes *N. improvisa,* i.e., those with larger darker papillae. Some of the uses of this latter name may actually refer to *N. diaphanes* but as noted above, without reexamining the actual specimens one cannot be certain. We here divide the records based on location assuming that this is correct most of the time.

Distribution.—Northeast Atlantic Ocean from shallow water.

Nephasoma multiaraneusa (Murina, 1967)

Golfingia multiaraneusa Murina, 1967b: 1332–1333, fig. 2.—Stephen and Edmonds, 1972:151.

Material examined.—ZIAS, Type material.

The hooks are the unique attribute of this species. They are 15–30 μm tall with a series of radiating filaments from the base giving each hook a spider-like appearance. The single 2 mm specimen is not a solid basis for a species but we propose no change at this time. If future collections in this region do not uncover additional specimens the status of this worm should be reconsidered.

Distribution.—Cuba at 4 m.

Nephasoma novaezealandiae (Benham, 1904)

Phascolosoma novae-zealandiae Benham, 1904:301–303, pl. 15, figs. 1–2, pl. 16, fig. 8; 1909:82.
Golfingia novae-zealandiae.—Edmonds, 1960:162–163.
Golfingia novaezealandiae.—Stephen and Edmonds, 1972:151.

Material examined.—None.

The type of this species was taken from the stomach of a dogfish and five years later a second worm was found in ooze. Edmonds added two more specimens, all four coming from near New Zealand. The trunk length ranges from 25–235 mm with introverts much shorter than the trunks. As noted by Edmonds this species is morphologically

similar to *N. eremita* but because of its geographic separation, the large number of thin, thread-like tentacles, and large size, it has been considered a separate taxon. Subspecific rank may be more appropriate but we propose no change at this time.

Distribution.—Off New Zealand and Chatham Is. from 65–70 m.

Nephasoma pellucidum pellucidum (Keferstein, 1865)

Phascolosoma pellucidum Keferstein, 1865: 433, pl. 32, figs. 26–27.—Baird, 1868: 86.—Selenka et al., 1883:32–34.—Shipley, 1899:155.—Sluiter, 1902:34.—Augener, 1903:299–300.—Lanchester, 1905: 28.—Southern, 1913:6.—Fischer, 1914:8; 1919:281; 1922a:17; 1923:23.—tenBroeke, 1925:83.—Leroy, 1936:425.

Golfingia pellucida.—Murina, 1968a:421–422; 1972:302–303.—Stephen and Edmonds, 1972:152–153.—Cutler, 1973: 159–162; 1977a:143; 1977b:152.—Cutler and Cutler, 1979b:105; 1980a:2.—Cutler and Murina, 1977:177.—Thompson, 1980:258.—Cutler et al., 1984:270.

Sipunculus (*Phascolosomum*) *pellucidus* Quatrefages, 1865:620.

Phascolosoma riisei Keferstein, 1865:437.—Baird, 1868:96.

Phascolosoma cinereum Gerould, 1913: 396–398, figs. 6–7.

Golfingia cinerea.—Stephen and Edmonds, 1972:138.

Phascolosoma sluiteri tenBroeke, 1925:84–86.

Golfingia sluiteri.—Stephen and Edmonds, 1972:156–157.—Cutler and Murina, 1977:177, 182.

Phascolosoma verrillii Gerould, 1908:488–489; 1913:388–391.

Golfingia verrillii.—Murina, 1964a:243–246.—Stephen and Edmonds, 1972:158.

Golfingia coriacea.—Fisher, 1950:551; 1952:396.—Not Murina, 1972:298.

Not *Phascolosoma coriaceum* Keferstein, 1865:432.

Golfingia eremita var. *australe.*—Wesenberg-Lund, 1959:181–182.

Material examined.—MNHU, Type specimens; numerous recently collected specimens; USNM, *G. cinerea* type, Fisher's specimens of *G. coriacea*; ZMUA, *G. sluiteri*; ZIAS, Murina's *G. coriacea*; UZMK, Wesenberg-Lund's *G. eremita* var. *australe.*

This species with large uniformly distributed papillae is well founded and widely distributed. In Cutler and Murina (1977) *G. sluiteri* was reduced to a junior synonym since it turned out to be merely *N. pellucidum* with its esophagus everted through the mouth. *Golfingia verrillii* was reduced in status in Cutler (1973).

Golfingia cinerea was alleged to be distinct because of its stouter trunk (length 3 vs. 5–9 times the diameter), a greater variety of papillae shapes, and the relationship between the nephridiopores and anus. Our analysis of some large collections showed there to be sufficient variation within one population to include this species. When Gerould erected this species he did not compare it to *N. pellucidum* nor did he record any from the U.S. east coast. Ditadi and Migotto (1981) suggested that *G. cinerea* should be considered a junior synonym of *N. confusum.* As discussed above we disagree and place it here.

In Cutler (1973) *G. coriacea* was synonymized with this species based on an examination of Fisher's material. While we still believe Fisher's worms to be this species, Keferstein's species name has been transferred to *Themiste* with some uncertainty due to the loss of the type material (Gibbs et al., 1983). Murina's specimens of this species are without doubt a *Themiste.*

Wesenberg-Lund's *G. eremita* var. *australe* bears distinct hooks and in other ways clearly resembles this taxon. Murina's (1972) record from near Prince Edward Island (Subantarctic waters) is based on three worms all less than 6 mm long. We have been unable to confirm this record and

question its validity. Edmonds (1982) questions the validity of earlier *N. pellucidum* records from Australian waters and suggests that they are probably *N. schuttei*. In Thompson (1980) *G. pellucidum* is listed in a brief checklist but no morphological or location data are given. This is the only suggestion that it occurs in the eastern Pacific and one hopes for a fuller statement in the near future.

Distribution.—Shallow-water species (few bathyal records) from the Western Atlantic and Caribbean down to Brazil, in the South Pacific (Indonesia/Australia), southern Japan, and one record from Cape Town.

Nephasoma pellucidum subhamatum (Sluiter, 1902), new status

Phascolosoma subhamatum Sluiter, 1902: 35–36, pl. 3, figs. 10–12.

Golfingia subhamata.—Stephen and Edmonds, 1972:157.—Cutler et al., 1984: 270–271.

Material examined.—ZUMA, Type specimens.

This taxon compares with the nominate form in most ways but is a bathyal western Pacific population (not shallow warm water). The only morphological feature which differs is that the hooks in this form are larger (100 vs. 60 μm) and thinner. The type material has not been preserved well and the internal organs are macerated. One of the worms from Sluiter's Sta 126 is a *Thysanocardia.*

Distribution.—Indonesia and central Japan at 440–2050 m.

Nephasoma rimicola (Gibbs, 1973)

Golfingia rimicola Gibbs, 1973:74–80; 1977a:18.—Saiz-Salinas, 1980:54–56.

Material examined.—Several specimens from type locality identified by P. Gibbs.

This is the only species in the genus to have its hooks arranged in distinct rings, which serves to differentiate it from species such as the very similar *N. minutum.* It also has its anus posterior to the nephridiopores; *N. minutum* has the reverse relationship.

Distribution.—Southwest England and northern Spain in intertidal waters.

Nephasoma rutilofuscum (Fischer, 1916)

Aspidosiphon rutilofuscus Fischer, 1916:17.

Phascolosoma aspidosiphonoides Fischer, 1922c:11–12, pl. 2, fig. 8.

Golfingia rutilofusca Fisher, 1952:395.—Stephen and Edmonds, 1972:153–154.—Cutler, 1977a:143–144.—Cutler and Cutler, 1979a:958–961.

Material examined.—MNHU, Type specimen; many recently collected specimens.

This western Indian Ocean species is the most distinctive member of this genus and may well merit separate generic rank if one chose to weight the unique tentacular crown more heavily; we do not at this time. The rusty red color makes this form easy to identify. The posterior end of the trunk sometimes appears shield-like but this is not permanent as it varies with body wall contraction. It may be misleading as it was for Fischer who originally placed it in the genus *Aspidosiphon.* See Cutler and Cutler (1979a:958–961) for a redescription and illustrations.

Distribution.—Western Indian Ocean from 1–1562 m.

Nephasoma schuttei (Augener, 1903)

Phascolosoma schuttei Augener, 1903:335–337, figs. 17–18.

Golfingia schuttei.—Stephen and Edmonds, 1972:156.—Edmonds, 1980:25–27.—Not as per Cutler, Cutler and Cutler, or Murina.

Material examined.—MNHU, Type specimen.

This name has been widely misapplied in recent decades by Murina and Cutler. They

have used the name for a small deep-water species very common in two major oceans (see *N. diaphanes*). This error became obvious when we examined the type. Edmonds' (1980) material and excellent description are correctly based on Augener's species. The large dark papillae and coarse skin are distinctive. Edmonds gives a detailed description and discusses the similarities to *N. pellucidum*. This is a distinct and valid species but the unfortunate confusion may continue to be a problem for some time until all workers understand and accept this narrower, original definition.

Distribution.—South and West Australia from intertidal waters.

Nephasoma tasmaniense (Murina, 1964)

Golfingia tasmaniensis Murina, 1964a:242–243, fig. 13a–b.—Stephen and Edmonds, 1972:157.

Material examined.—ZIAS, Two type specimens and one additional specimen identified by Murina.

Both type specimens are incomplete and damaged worms lacking introverts. What were described as tentacles are actually the broken introvert retractor muscles. The third worm (unpublished record from 9°S, 71°E at 2218 m) is intact with an extended introvert. Small pale hooks and a few reduced tentacles are present on a swollen, bulb-like terminal part of the short introvert (less than half the trunk length). The anterior 4 mm of the trunk has the conical shape with a collar at the base of the cone, as figured by Murina (total trunk length is 18 mm). The trunk/introvert junction is constricted into a narrow neck. This species has an uncertain foundation being based on two incomplete worms and the flawed description. The absence of any differential diagnosis is another problem.

In general size, shape, looseness of gut coil, constricted neck, and short introvert with bulbous tip, it resembles *N. constricticervix*. The hooks are much smaller and

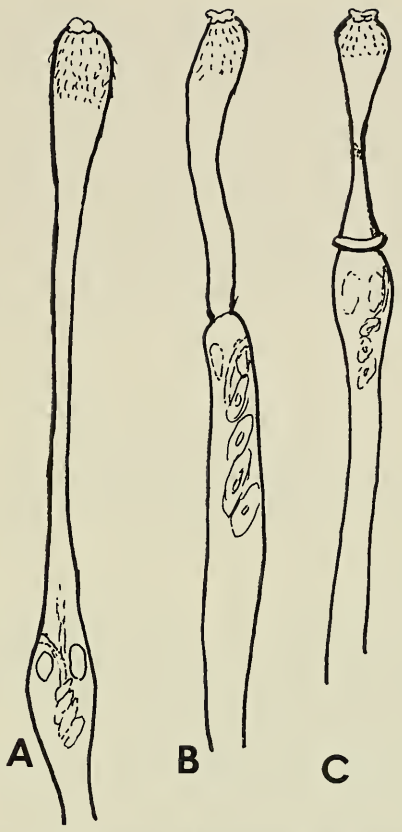

Fig. 3. Introvert and anterior end of three elongate, slender, deep-water *Nephasoma* species; A, *N. capilleforme*; B, *N. cutleri*; C, *N. tasmaniense*. Drawn as if trunk lengths were equal to show comparative lengths of introverts.

the collar at the base of the anterior cone may be diagnostic. In several ways this species is similar to other long, slender, deep-water members of this genus. A more adequate description and diagnosis is needed. In anticipation of this by Murina, we propose no change in the status of this species.

Distribution.—Tasman Sea at 1330 m.

Nephasoma vitjazi (Murina, 1964)

Golfingia vitjazi Murina, 1964a:246–248, fig. 16a–b.—Stephen and Edmonds, 1972:158.

Material examined.—ZIAS, Type specimen.

This single specimen is incomplete with a torn posterior end, and measures 15 × 0.08 mm. The anterior end has 30–35 parallel, longitudinal ridges forming what has been called a "shield." The 4 mm introvert bears large hooks (210–280 μm) which is unusual in this genus. While there is only this single specimen known, we propose no change in the status of this species.

Distribution.—Northwest Pacific Ocean at 4150 m.

Nephasoma wodjanizkii wodjanizkii (Murina, 1973), new status

Golfingia wodjanizkii Murina, 1973a:944–945; 1973b:70.—Frank, 1983:18–19.
Golfingia nicolasi Thompson, 1980:951–956.

Material examined.—ZIAS, Type specimen and one other *N. wodjanizkii*; several specimens of *N. nicolasi* from type locality identified by B. Thompson.

This slender, bathyal species, with its two subspecies, has nephridia posterior to the anus, retractors originating in the posterior ⅕ and an introvert of varying lengths. In very young animals it is shorter than the trunk, it grows to two to three times the trunk in mature worms but in some populations, when completely extended, it may reach six to seven times the trunk length. Small hooks may be present and the tentacles are few and reduced.

The two *N. wodjanizkii* have 4 mm and 6 mm trunks with longitudinal lines along most of the trunk and part of the introvert. These worms were said to have indistinct shields at both ends of the trunk but we would not use this term. The introverts are about three times the trunk length but incompletely extended so nothing can be said about tentacles or hooks.

The California population of *Nephasoma nicolasi* is based on several hundred specimens with 7–36 mm trunks. The introverts range from 0.5 (in the smallest) to seven times the trunk length, longer than most species in this genus. No hooks have been seen. The introvert and the anterior end of the trunk have a series of longitudinally arranged fine brown lines (ridges in the epidermis).

A comparison of these two forms showed the differences to be artifacts of small sample size on the one hand and a failure to make a comparison on the other hand. When Thompson was analyzing his population he probably did not consider Murina's species since one had hooks and the other did not. There was also an apparent difference in trunk size and introvert length. Murina's use of the term shield could also have been misleading. It is our conclusion that these two taxa are conspecific and, despite the fact that Thompson's data base is superior his species must be submerged as a junior synonym.

Distribution.—Sea of Okhotsk, Peru-Chile Trench, and southern California from 1000–2400 m.

Nephasoma wodjanizkii elisae (Murina, 1977), new status

Golfingia elisae Murina, 1977:133–134.
Nephasoma elisae.—Gibbs, 1986:338–339.

Material examined.—ZIAS, Type specimen; UZMK, cotypes; 2 specimens from the eastern Atlantic.

There are two problems with the description of this taxon: rather than the 11–13 longitudinal grooves forming the anterior shield there are 25–30; secondly, hooks have only been observed once (Murina) and appear to be deciduous, a feature shared with many species in this genus. A comparison of these two taxa, as corrected, shows them to be remarkably similar except that the introvert length in *N. w. elisae* is less than twice the trunk length. Our decision to retain this name at the subspecific rank was largely based on the fact that this represents the Atlantic Ocean population while the nominate form is a Pacific Ocean population.

Distribution.—Gulf of Guinea at 1520 m and from 43–58°N from 1600–2300 m in the northeast Atlantic Ocean.

Species Names Transferred to Other Genera or Considered species inquirendum or incertae sedis

Nephasoma chuni (Fischer, 1916)

Phascolosoma chuni Fischer, 1916:15; 1922c:9.

Golfingia chuni.—Stephen and Edmonds, 1972:136–137.—Murina, 1973b:68.

Material examined.—MNHU, Type specimen.

One of the two bottles in Berlin labelled *P. chuni* contained a poorly preserved nematode. The second bottle contained a worm with completely disintegrated internal organs except for the one pair of retractor muscles. Therefore, it is impossible to verify anything about its internal anatomy. Externally it resembles the *N. pellucidum* complex but there are too many unanswerable questions (see Stephen and Edmonds 1972:137) to do anything other than place this name on the list of incertae sedis.

Nephasoma delagei (Herubel, 1903)

Phascolosoma delagei Herubel, 1903:100; 1907:115–117.

Golfingia delagei.—Stephen and Edmonds, 1972:139–140.

Material examined.—None.

In 1922 Cuenot treated this as a junior synonym of *Golfingia elongata.* Gibbs (1973) agreed but since the type has been lost he considered it to be indeterminable. We concur and place this name on the list of incertae sedis.

Nephasoma depressum (Sluiter, 1902)

Phascolosoma depressum Sluiter, 1902:39–40.

Golfingia depressa.—Murina, 1964a:227–228.—Stephen and Edmonds, 1972:140.

Material examined.—ZMUA, Type specimen; ZIAS, Murina's (1964) specimen.

The type specimen has a 4 mm trunk, is poorly preserved, and the introvert is missing. Murina's worm is 2.5 mm long and she noted that her comparison was hampered by the 'poor intactness' of her worm and Sluiter's incomplete description. We place this name on the list of species inquirendum pending future clarification because of the poor condition of these two very small specimens and the puzzling nature of the descriptions.

Nephasoma fimbriatum (Sluiter, 1902)

Phascolosoma fimbriatum Sluiter, 1902:34–35.

Golfingia fimbriata.—Stephen and Edmonds, 1972:143.—Murina, 1976:64.

Material examined.—ZMUA, Type specimen; ZIAS, two of Murina's worms.

This bathyal species is not solidly founded and the descriptions contain some discrepancies. The anterior part of the trunk is narrowed but by definition, the position of the nephridiopores coincide with the introvert–trunk junction. The nephridiopores open 2 mm posterior to the anus and not on the introvert. The introvert is retracted to an unusual degree so that the anterior 5 mm of the trunk is also retracted and while the introvert is shorter than the trunk (7 and 25 mm) this is not the normal condition. The papillae on the introvert are not unusually long. The retractor muscles originate very near the posterior end of the trunk (85–95%) which is not common in this genus.

Of greatest significance is the presence of contractile vessel villi. These structures are present but not on the free portion of the esophagus, only in the beginnings of the gut coil. We suspect that this is an artifact of the extreme state of contraction and in the extended state this portion of the gut would be uncoiled. This removes the ambiguity of earlier statements (Cutler and Murina 1977).

Although it is not extended the tentacular crown appears to be short festoons. These two features point towards *Thysanocardia* but the short introvert and anus–nephridiopore relationship do not fit that pattern. While we are inclined to place this in the synonymy of *T. nigra* we are hereby placing this name on the list of species inquirendum pending future clarification based on additional specimens.

Golfingia intermedia (Southern, 1913)

Phascolosoma intermedium Southern, 1913: 3–5, pl. 1, figs. 1–8.—Stephen, 1948:219.
Golfingia intermedia.—Stephen and Edmonds, 1972:147.—Gibbs, 1977b:109–112.

Material examined.—None.

When Gibbs (1977b) examined the type material he concluded that these specimens are merely immature *Phascolion strombus.* We concur with that conclusion.

Golfingia macra (Sluiter, 1891)

Phascolosoma macer Sluiter, 1891:114–115, pl. 2, figs. 13–14; 1902:34.
Golfingia macra.—Stephen and Edmonds, 1972:149.—Cutler and Murina, 1977: 183.

This species was discussed in Cutler and Murina (1977) after examining the type material. It clearly belongs in the genus *Aspidosiphon* and is an emended spelling of the original *P. macer.*

Golfingia pavlenkoi (Ostroumov, 1909)

Phascolosoma pavlenkoi Ostroumov, 1909: 323.
Golfingia pavlenkoi.—Stephen and Edmonds, 1972:152.—Cutler and Murina, 1977:175.—Gibbs et al., 1983:301.

Material examined.—None.

Cutler and Murina (1977) discussed this species and concluded that it was a junior synonym of *Golfingia* (*Thysanocardia*) *catharinae.* However, when Gibbs et al. (1983) reviewed *Thysanocardia* and elevated it to generic rank, this species name went into the synonymy of *Thysanocardia nigra.*

Nephasoma prioki (Sluiter, 1881)

Phascolosoma prioki Sluiter, 1881:152–153, pl. 1, figs. 5 and 9; 1891:115; 1902:34.—Selenka et al., 1883:37.—Selenka, 1885: 12–13.
Golfingia prioki.—Stephen and Edmonds, 1972:153.—Cutler, 1977b:153.

Material examined.—ZMUA, Type specimen.

This taxon has a very uncertain foundation. The first four references are all repetitions of the single holotype. Selenka's 1885 record was based on one additional worm. The three worms in Cutler (1977b:153) ". . . seem to fit this poorly known species." What has been overlooked is the presence of small but real contractile vessel villi and the nature of the tentacles which are withdrawn. At present, after our work on the genus *Thysanocardia,* it is clear that these four worms fit the criteria for that genus and are closest to *T. nigra.* The age and preservation history of the material makes positive identification difficult. The depth of Sluiter's worm (962 m) is also greater than other *T. nigra.* Nevertheless, *N. prioki* now becomes a junior synonym of *T. nigra.*

Nephasoma vitreum (Roule, 1898)

Phascolosoma vitreum Roule, 1898:386; 1906:86–90.
Golfingia vitrea.—Stephen and Edmonds, 1972:158–159.

Material examined.—None.

The type and only representative of this species cannot be located and in the intervening 88 years no additional specimens fitting this rather peculiar description have been collected from these bathyal eastern

Atlantic waters. We therefore place this name on the list of incertae sedis.

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Appendix 1.—Certain morphological characters of *Nephasoma* species.

Trunk length in mm	Introvert length as % trunk	# of gut coils	Nephridiopores anterior to anus by % of trunk	Origin of retractors (% of trunk)	Muscles	
					Spindle	Fixing
			Nephasoma flagriferum			
120	108	70	8	23	+	0
97	75	45	4	28	+	1
90	51	70	1	22	+	0
85	67	6	4	27	+	2
83	87	80	2	37	+	0
82	52	60	4	29	+	0
77	130	70	4	35	+	0
77	56	60	1	23	+	1
75	?	60	1	24	0	0
75	85	60	4	47	+	0
72	?	85	7	22	+	0
63	106	60	3	28	+	1
61	162	80	2	48	+	0
58	121	25	2	16	+	1
55	89	50	4	33	+	0
54	111	?	4	20	+	1
40	165	6	4	35	+	1
35	71	14	9	37	+	0
32	147	45	9	25	+	0
27	96	?	?	?	?	2
9	200	25	11	39	+	0
7	457	20	7	57	+	1
6	250	25	7	42	+	0
5	140	25	20	50	?	?
5	100	20	0	40	?	?
4	100	20	0	50	?	0
3.5	143	15	14	43	?	?
			Nephasoma constrictum (posterior)			
30	33	40	3	53	0	0
29	62	40	5	55	0	0
29	45	?	7	69	+	1
25	88	30	4	64	0	0
23	104	25	7	57	+	0
22	59	40	9	59	0	0
20	60	35	3	55	+	0
20	80	30	10	50	+	0
18	78	35	6	56	0	1
17	82	28	18	59	+	1
15	60	35	3	67	+	1
13	77	30	12	38	+	0
12	83	20	8	67	+	0
10	80	30	10	50	+	0
8	113	20	6	50	?	?
7	157	15	11	71	0	0
7	214	20	14	57	+	0